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# Units of reference level for measurement

## ◇Summary of measurement units and calculation of noise level

*[～*Application*～]*

You may find plenty of measurement units in documents or references on wired or non-wired communication equipment.
This application note gives you the explanation about units of noise measurement,
and also supported units on MSA300/400 series spectrum analyzers.

### ■Supported measurement units on MSA300/400 series

You can read out the noise level in 6 measurement units,
dBm, dBμV, dBmV, dBV, dBμV/m and dBμA/m on MSA300/400 series spectrum analyzers.
(dBμV/m only for electric field intensity and dBμA/m only for magnetic field intensity)

The unit, dBm, is the expression in decibel value normalized by 1mW power, and this means 1mW equals to 0dBm.
The following formula can convert the value from dBm unit to mW unit. Power[dBm] = 10log (Measurement-Power[mW] / 1[mW] )
Reversely, the following formula gives you the way of conversion from dBm to mW. Power[mW] = 10^ ( Measurement-Power[dBm] / 10 )

The following table shows the conversion formula from dBm to each unit. (50Ω impedance).

| Unit | Conversion formula | Purpose | Comments |
|---|---|---|---|
| dBμV | [dBμV] = Measurement-Power[dBm] + 107 | Power | |
| dBmV | [dBmV] = Measurement-Power[dBm] + 47 | Power | |
| dBV | [dBV] = Measurement-Power[dBm] − 13 | Power | |
| dBμV/m | [dBμV/m] = Measurement-Power[dBm] + 20log { 2π / λ ・SQRT ( 2.4/Gar ) } + 107 | Electric Field Intensity | λ :Wave length[m]、Gar:Absolute gain of antenna |
| dBμA/m | [dBμA/m] = Measurement-Power[dBm] + F + 107 | Magnetic Field Intensity | F for Micronix CP-2SA magnetic field probe<br>10MHz : 86.7dB, 100MHz : 69.2dB,<br>1000MHz : 50.7dB, 2000MHz : 44.7dB,<br>3000MHz : 40.1dB |

### ■Units for noise measurement

The value of noise power can be easily calculated through the conversion from measurement values on Micronix's spectrum analyzer.

| Unit | Conversion formula | Comments |
|---|---|---|
| dBc/Hz | L(fm)[dBc/Hz] = Pn(fm) − Pc − 10log(RBW×1.2) + 2.5 | Pn(fm):RBW Noise power at fm [dBm], fm: offset frequency[Hz]<br>Pc : Carrier power [dBm] |

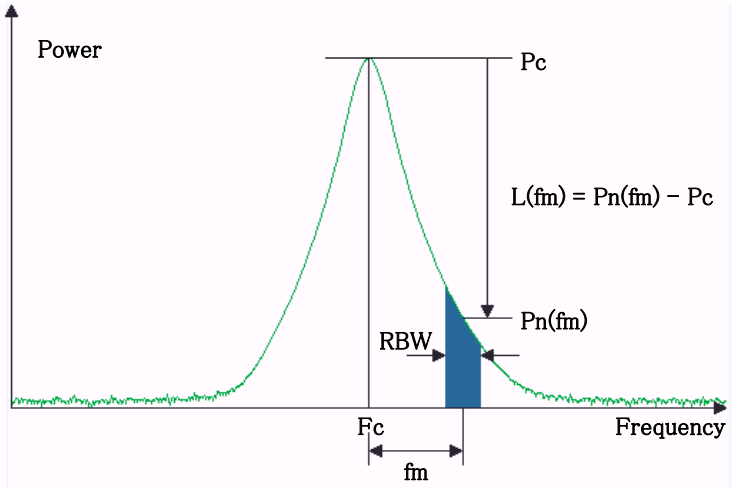
The calibration is theoretically required for SSB phase noise measurement on a spectrum analyzer.

Here are the reasons for the calibration.
1.The difference of the RBW filter characteristic from ideal rectangle shape.
The RBW should be expanded by 20% for conversion by RBW

2.The compression of noise power at logarithm amplifier.
2.5 dB should be added to the SSB noise.

In conclusion, the SSB phase noise per Hertz is calculated by the following formula.

L(fm)[dBc/Hz] = Pn(fm) − Pc − 10log(RBW×1.2) + 2.5



Relation of setting values for noise measurement

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